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ABSTRACT

Science fairs have the potential to help students develop new ways of solving problems using a scientific approach. This document is intended to be used by junior high students in planning and developing a science fair project. Several suggestions are offered to help students decide on a project, with a listing of 60 topical areas in science presented. Guidelines for the design of experimental projects are provided, including safety precautions and tips for collecting data, analyzing observations and drawing conclusions. A suggested format for the written portion of the project is presented. Design guidelines for the visual exhibit of the project urge students to be innovative and creative. A list of questions for students to consider as they complete their projects is provided. These questions relate to the ways that the judges may look at the students' projects and are intended to help student more effectively explain their work. (TW)

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SCIENCE FAIR

Student Handbook

SE 047 636

STUDENT HANDBOOK

SCIENCE FAIR
IT'S A BLAST!

A Guide for Junior High Students

Sponsored and funded by:

Regional Superintendent of Schools
Lake County, Illinois

Illinois State Board of Education

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A MESSAGE TO PARENTS

It is the intent of this booklet to help your child develop a science fair project. As a parent, you can play a vital role in the Science Fair. We encourage you to work with your children but ask that you do not develop the project for them. Listen to them, draw out questions, and provide possible solutions. Above all, give your child encouragement!

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MISSION: POSSIBLE

By using your interest in science, no matter has small, the science fair project will help you develop new ways to solve problems by using the scientific approach.

YOUR SCIENCE FAIR PROJECT...choose your mission

Have you ever wondered about something? Been even more than curious? Believe it or not, you use the experimentation method to discover answers to questions you face every day.

A science fair project involves curiosity, experimentation and discovery. It is:

Choosing a topic that is interesting to you and one you want to know more about.
Deciding to make a commitment to see your project through from start to finish.
Visiting places and talking to people.
Forming a question and guessing at an answer.
Designing an experiment.
Carrying out this experiment.
Recording observations.
Analyzing results and deciding if your guess is correct.
Preparing your scientific research paper, your exhibit, and your presentation.
Presenting your project to your classmates, judges, and the public.
Knowing you did something worthwhile!

GETTING STARTED...fuel your rocket

1. Sit down and make a list of hobbies and things you wonder about. You can get this list started by thinking about places you've visited, things you've seen or read, people you've talked to and other experiences you've had.

2. Take this list and visit libraries. Look up information on some of your ideas using science books, lab manuals, science fair yearbooks, and magazine and newspaper articles. All information should be recorded on notecards or in a notebook. Sources should be noted for your bibliography. This information will be useful for your review of literature.

3. You may also wish to visit museums, zoos, hospitals, businesses, laboratories or colleges and talk to teachers, doctors, pharmacists, dentists, nurses, research personnel, pilots or other people who know something about your ideas.

4. You should now be able to select an idea from your list and form a question that you can answer with an experiment.

5. Go back to the literature and your other resources. Begin an in-depth study of your topic. The more research you do, the better you will understand your project. Be sure to continue to record all information on notecards or in a notebook. This will help you to organize your paper.

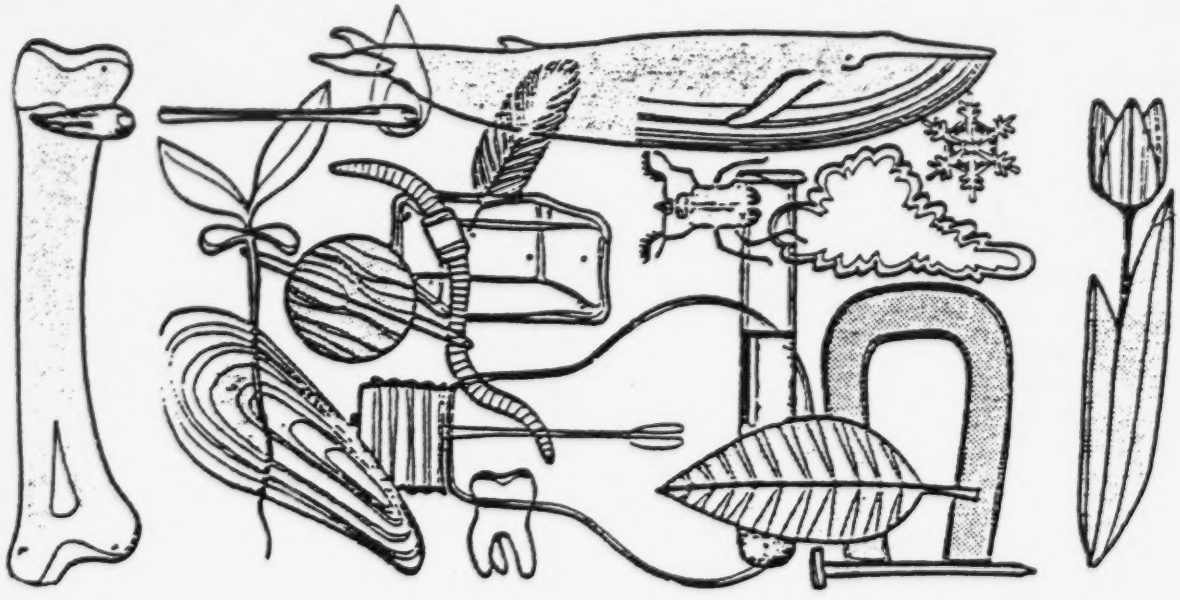
SUGGESTION: For the most current information, use the "Readers' Guide to Periodical Literature."

6. Before you begin to design your experiment, make a guess about the answer to your question. This guess is called your HYPOTHESIS.

7. The purpose of your experiment would be to prove your hypothesis.

SIXTY SENSATIONAL SCIENCE TOPICS

Aerodynamics
Airplanes
Amphibians
Anatomy
Astronomy
Automation
Birds
Bones
Cells
Chemistry
Computers
Conservation
Digestion
Dinosaurs
Earth
Electricity
Endocrine System
Energy
Engines
First Aid
Fish
Flowers
Fossils
Geology
Gravity
Heart
Heat
Horses
Human Body
Insects
Inventions
Invertebrates
Light
Machines
Magnetism
Mammals
Migration
Muscular System
Nervous System
Nutrition
Oceanography
Parasites
Photosynthesis
Planets
Plants
Pollution
Prehistoric Life
Public Health
Reptiles
Respiratory System
Rockets
Rocks
Senses
Shells
Solar System
Sound
Tides
Trees
Water
Weather



DESIGNING YOUR EXPERIMENT...ready your launch pad

Plan your experiment to test your hypothesis. Your plan should be written in a step-by-step procedure that other people can follow. You should estimate how many weeks it will take to accomplish each part of your experiment. Add the weeks together and make sure you allow for problems that may arise.

CAUTION: If you are using animals, treat them in such a way that they will not suffer. Do not do anything to them that you would not do to yourself.

REMEMBER: You should design your experiment so that it is CONTROLLED. This means that you must regulate anything that could influence the outcome of your experiment.

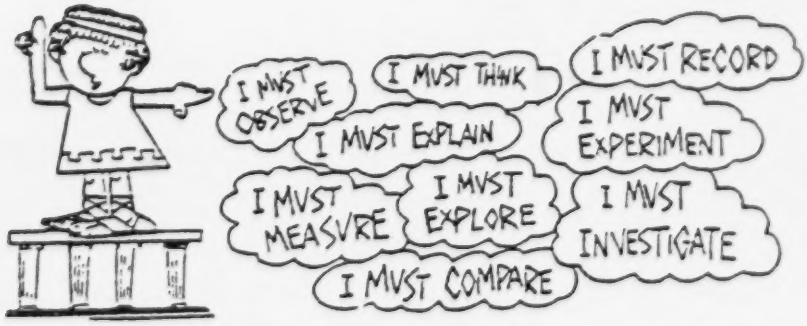
EXAMPLE

> If you were going to determine in what type of soil a strawberry plant would grow best, your hypothesis could be that the best soil contains equal amounts of sand, clay and humus. To test this you would make up different mixtures of different amounts of sand, clay and humus.

Using the above example, you can now select your VARIABLE. Your variable is the different amounts of sand, clay and humus. All other factors such as temperature, light and water must be kept the same. You can only change the amounts of sand, clay and humus.

It is best to design an experiment so that there is a control group and an experimental group. The experimental group contains the variable. The control group is a standard of comparison to the experimental group.

A good experiment contains a number of trials. In the case of the strawberry plant experiment, the same number of plants (at least three) should be used in the control group and in the variable group(s). In the case of an experiment in which large numbers cannot be grouped, repeated trials may be necessary.



SAFETY FIRST

Be aware of dangers. Make sure you are fully aware of what things might possibly go wrong and take steps to prevent them. The following safety rules are more thoroughly explained in the 1984 Guide Book and Policy Manual of the Illinois Junior Academy of Science (p. 3). If you wish to be included in the Regional or State Science Fair, they must be followed. However, even if you are only having a local fair, you still need to be safe.

CHEMICAL AND GLASSWARE HAZARDS

For display purposes, glassware must be securely mounted. Chemicals may not be displayed. Use colored water or photographs instead.

FIRE AND RADIATION HAZARDS

1. No explosives, fuels, poisonous materials, or aerosol cans are to be displayed.
2. Radiation projects must not be dangerous. Ask a specialist in the field to check your idea.
3. Ultraviolet light may be used during judging only.
4. No boxes, etc., under your exhibit table.

BIOLOGICAL HAZARDS

1. No living vertebrate (backbone) animals may be displayed.
2. No hypodermic needles and syringes can be displayed.
3. Molds and bacteria that are unknown or dangerous to humans should not be displayed. Use photos. You may display, SEALED IN PETRIX DISHES, harmless molds and bacteria--ones you obtained from a supply house or other place where they were identified.

ELECTRICAL AND MECHANICAL HAZARDS

1. All moving parts must have protective covers.
2. Machinery must be well built.
3. Equipment and switches should use 110-115 volt A.C. or dry cells.
4. Connections and devices to secure wires should be insulated, and the wires need to be the right size for the use and voltage.
5. Noisy devices may be operated only when requested by judges.
6. Spark dischage equipment must not interfere with communications channels.
7. Any device constructed by a student must have a suitable cord of at least six feet (2 meters) with a 3-prong plug. Lamps may have a 2-prong plug.

SAFETY INSPECTION AT REGIONAL AND STATE FAIRS

Exhibits will be inspected before judging. Easily corrected safety violations must be corrected on the spot, otherwise your project will be disqualified.

CARRYING OUT THE EXPERIMENT...countdown begins

Make a list of all materials that are necessary for your experiment. Find out where they can be obtained and do so. Assemble all materials before you begin. You will be amazed to find that you may use many household items in place of expensive laboratory equipment. It will hold down your cost if you do a little searching and substituting. But be sure to use calibrated scientific equipment for accurate measurement.

You are now ready to begin. Find an organized, quiet area where you can perform your experiment without interference from anything or anybody. It is important that everything be done as accurately and carefully as possible. Make sure you perform your steps the same way each time you carry out the experiment. If problems develop, try to figure out what went wrong and then change your procedures to correct the situation. Any changes should be noted in your procedure and this may become part of your experiment. As you do an experiment you may find more questions popping into your head. You may want to redesign your experiment to find solutions to these questions. This is how an outstanding project is born.

All measuring should be done accurately and consistently. It is recommended that all measurements be made in the metric system when possible.

1. NOTING RESULTS

   A. Recording Observations. Keep a detailed daily record (logbook) of measurements, changes and problems. It is better to have too much information than not enough. Make sure you are measuring the effects of the variable. (Example: Measuring the height of a plant is NOT the only indication of the effect of the variable. Changes in leaf color, size and number may be more important.)

      Take photographs, make diagrams or drawings of various phases of your experiments.

      REMEMBER: There are no wrong results--just unexpected ones.

   B. Analyzing Observations. Look through your logbook and organize data into charts and/or graphs. These will make it easier for you to draw conclusions.

2. DRAWING CONCLUSIONS

Your conclusion is a statement telling whether your hypothesis was correct or not. This is based on the analysis of your observations.
DO NOT WORRY IF THE HYPOTHESIS IS PROVED TO BE INCORRECT.

You should now think about how you arrivd at your conclusion. Be sure to show how your results support your conclusion.

WRITING YOUR PAPER...3,2,1,Ignition

The written summary (paper) is the way you are able to accurately give detailed facts, descriptions, and results of your experiment. The ability to share what you have learned is a vital part of the scientific method.

Your paper should contain the following parts in the order given.

1. ABSTRACT

The abstract is a brief summary of your experiment. It should have three paragraphs containing a total of about 150 words.

Paragraph 1 - PURPOSE. What you set out to do.
Paragraph 2 - PROCEDURE. How you did it.
Paragraph 3 - CONCLUSION. The results and what they meant.

The abstract form also asks for other information. Your teacher will give you the form at the proper time.

2. SAFETY SHEET

It is important that you take every appropriate safety precaution during your experiment. On the safety sheet you should list the major hazards of your project and what you have done to make it safe and avoid injury.

3. VERTEBRATE ANIMAL ENDORSEMENT

This form may be required if your experiment uses vertebrates (i.e., animals with backbones, including humans). For more information, ask your teacher for help.
REMEMBER: DO TO ANIMALS ONLY WHAT YOU WOULD WANT DONE TO YOU.

4. TITLE PAGE

A good title gives a good first impression. Be sure to center it on the page. Your name, school, and grade are to be placed in the lower right-hand corner.

5. TABLE OF CONTENTS

This is a list of the sections of your paper and the page on which each begins. It should not include the Abstract, Safety Sheet, Vertebrate Animal Endoresement, or Title Page.

6. PURPOSE

This section should precisely state the purpose of the experiment in no more than three sentences. If you have developed a hypothesis, it should be stated here.

7. ACKNOLWEDGEMENTS

In this part you should give credit to the people and businesses who have helped you.

8. REVIEW OF LITERATURE

This is a summary of what you have read, seen, or heard about your topic. This information may come from journals, books, scientists, doctors, newspapers, films, etc.

This summary should include definitions of terms as well as previous research on your topic. You should also include background information giving general understanding about the scientific principles used in your project. For example, don't expect to find a book or article on your exact topic. If you are doing an experiment on the effect of temperature on crystals, background information could include sources about chemicals, evaporation, and heat.

For easy reading and to show your understanding, you should write the review of literature in YOUR OWN WORDS AND STYLE. When you must quote directly, do it sparingly and use quotation marks. You should give the author credit by including in parentheses his name, the copyright date, and page number.

EXAMPLE: (Jones, John, 1975, p. 82.)

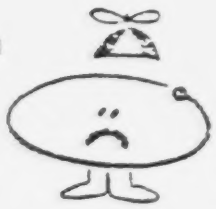
Your review of literature will be more valuable and intersesting if it comes from at least six sources of varying types (e.g., books, periodicals, journals, personal interviews, tapes, filmstrips, etc.).

REMEMBER: Proper note-taking is your biggest help in putting together your review of literature.

9. MATERIALS

Your list of materials should be complete and SPECIFIC so another student could collect them and duplicate your experiment. Note the right way to make this list:

LIST A - wrong



plants
water
soil

LIST B - right

12 coleus plants - 15 cm tall
10 mL H_2O every other day
300 g vermiculite

10. METHODS OF PROCEDURE

Explain in step-by-step detail how you did your experiment. Again, this should be so specific that another student may duplicate your experiment. You should give complete instructions for building any equipment. You may include pictures and drawings. You need to tell exactly what you did, how you did it, how much you used, and so forth. Don't leave out any detail which would keep another person from doing your experiment in the same way.

11. RESULTS (OBSERVATIONS)

This section tells what happened as you did your experiment. Special care should be taken to organize your results so they can be easily understood. Tables and graphs should be used if possible. Day-by-day logs are also useful. Precise measurements and good descriptive words make your results clear and accurate. Your results should include the failures and errors as well as the successes.

12. CONCLUSION

Do your results prove or disprove your hypothesis? In your conclusion, you are to summarize the results. You need to tell what these results mean and how accurate they are. Why did what happened happen? What suggestions would you offer for a repeat of the experiment? Be honest and factual about what happened. It's O.K. if your hypothesis was not proven.

13. BIBLIOGRAPHY

This is an alphabetical listing, by author's last name, of all the reference materials you used for your review of literature. Below is a sample bibliography page. Be sure to check with your teacher to see if this is an acceptable form for your school.

Granite, I. M. "How I Found Diamonds In Illionis," National Geographic Magazine, XVII (July, 1937), 412-419.

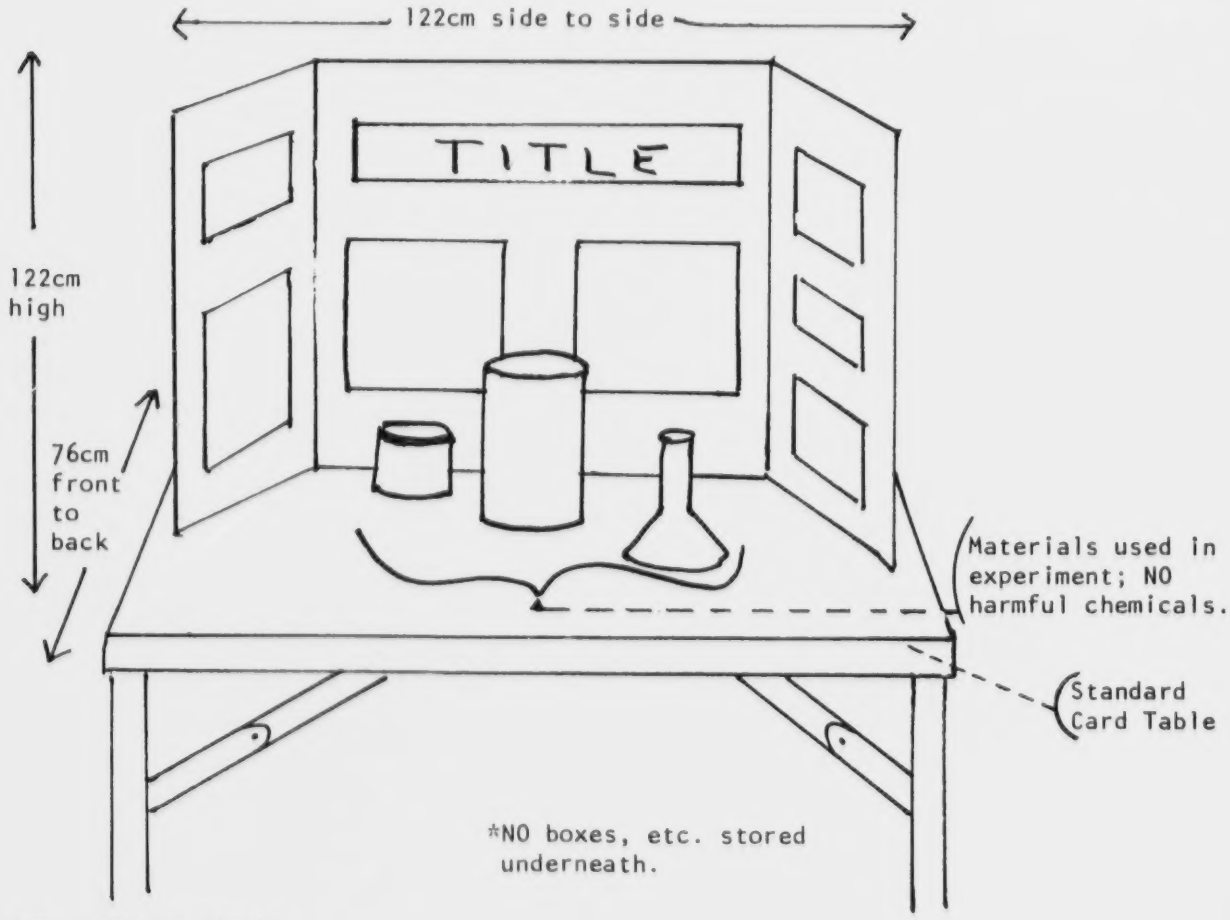
Light, Feather. How To Fly Like A Bird. Pigeon Roost, Maine: Bird Brain, Inc., 1982.

Smell, B. A. D. "Skunks," Encyclopedia Britannica (1981), 23:24-32.

Talks, A. L. O. T., Throat Specialist, interview at office, July 26, 1983, concerning throat cultures, Chicago, Illinois.

EXHIBITING YOUR PROJECT...lift off!

Your display should be self-supporting and designed to fit on a table, NOT THE FLOOR. One design follows here. Note the size limits. It should give the title and be designed to explain your project. How you do it is up to your own creativity.



YOUR DISPLAY SHOULD:

1. Stand alone and be sturdy. Possible materials might be heavy cardboard, display board (from an art store), masonite, pegboard, etc.
2. Be the correct size and NO LARGER (it may be smaller).
3. Be neat and use CORRECT SPELLING AND GRAMMAR. Capitalize correctly or use block letters.
   HINT: "Effect" is a noun. Example: The Effect of ___ on ___.
   "Affect" is a verb. Example: How Does ___ Affect ___?
4. Be colorful and attractive with an accurate title.
5. Have typed or lettered explanations on plain paper. Include graphs and charts which are in METRIC MEASURES.

MAKE YOUR DISPLAY INTERESTING

Photos help--especially enlargements (5x7 or 8x10).
If applicable, include materials you used to do the experiment.

BE CREATIVE IN PLANNING YOUR DISPLAY

Sketch your display design before attaching the materials to the board. Another way to do it is to lay the board down and arrange the materials in a pleasing manner.

THE JUDGING...mission accomplished

Asking yourself these questions may help you to understand what your judge(s) will be looking for.

1. Can you tell the judge(s) what you have learned by doing this project?
2. Have you chosen an experiment that you yourself could do?
3. Did your hypothesis come from scientific information that you read or learned in class?
4. Have you used the scientific method to solve your problem?
5. Have you set up a controlled experiment and gathered data?
6. Did you use equipment and methods that were appropriate for your experiment?
7. Have you used several sources of information rather than just one?
8. Have you written your paper in your own words rather than copying from a course?
9. Have you done most of the work yourself? (If you had help, have you given credit to those people who helped you?)
10. Have you repeated the experiment enough times to be certain of your results?
11. Did you report your results accurately, even if they were not what you expected?
12. Are you certain that the scientific facts you are stating are correct?
13. Have you drawn conclusions that fit the data you have collected?
14. Have you planned your oral presentation so that you can explain your project simply and in an interesting way?
15. Does your written report contain background information about your topic, a description of your experiment from purpose through conclusions, and a bibliography listing your sources?
16. If an abstract summary of your project is required, have you included one at the beginning of your paper?
17. Does your visual display clearly show your data in a neat attractive way?

You are now ready to enter the final phase of your science project adventure. The final step in the completion of your science fair project is to be ready to explain your project in a speech to the judge(s) on the day of the fair. This speech is very important because it tells the judge(s) what you have done and what you have learned from your project. To be ready for this, you will need notecards to help you remember the most important facts from your paper. Write on these notecards one or two sentences to summarize your background information and the purpose, experimental procedures, results and conclusions of your project. Then, use these notecards to practice your speech. A well-rehearsed speech will help you feel more knowledgeable and confident when you give your speech before the judge(s).

If you are working in a team of two students, you may wish to divide the oral presentation into sections and share the speaking, or select one of you to act as spokesperson for the team. However, both of you should be equally knowledgeable about your project from start to finish. In whatever way you present your speech, be sure that it runs smoothly and is easily understandable to the judge(s).

On the day of the judging you will be presenting yourself as well as your project. Good grooming can be an important factor in the total picture that you present to the judge(s). It is suggested that you dress neatly and leave your chewing gum at home.

While waiting to be judged, stand quietly by your project at all times. Do not do or say anything that might disrupt the judging of other students near you.

When the judge walks up to your project, introduce yourself by telling your name, grade level, the title of your project and a brief description of how you became interested in your experiment. Allow 5 to 10 minutes for the oral presentation that you have prepared. While presenting your project orally, speak slowly and clearly, being careful to make eye contact with the judge(s) occasionally rather than reading word-for-word from your notecards. As you are speaking, you may point out graphs, charts or pictures on your display board to help you explain your project. Be aware that you may be interrupted by the judge(s) with a question at any time during your presentation. If this happens, answer the question as best you can and then continue with your prepared speech. At the conclusion of your presentation, be ready to answer any further questions the judge(s) may have. If you do not know the answer to a question, be honest and say so. Before the judge leaves your project, offer him/her your written report for further study.

CONGRATULATIONS! YOUR SCIENCE PROJECT MISSION IS ACCOMPLISHED!

NEED EXTRA COPIES?

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Ted Sanders
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